An Analysis of Mock-Up Furniture Making Method for Yachts

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Abstract

In the developing yacht sector, the importance of design, efficiency and conceptual compatibility has increased in time. The most important stage of yacht production in this sector is furniture making. Yacht furniture making has three different methods: on-site, mock-up and computer-controlled. The aim of this study is to elaborate on mock-up method, with describing its process in sequence so as to emphasize its advantages and disadvantages in detail. Interview with the director of a boatyard: Adayachtworks and observation made in the company are the two main methods of data collection. Interview is a compilation of five open-ended questions. Naturally, a big amount of data is recorded and reported at the end. So, only the answers reasonable were taken into the article. Observation on the other hand was reported in the internship file. Critical points of furniture design and production stages in the file are referred in the text. As a result, it can be stated that the mock-up method is more advantageous than other methods in many aspects: saves time, makes conceptual design and precise craftsmanship work together, easier and provides a visual perception of what is realized during the ongoing production, safer and finally facilitates the budget management.

Keywords - *yacht furniture making, mock-up method, furniture production*

I. INTRODUCTION

In the developing yacht sector, the importance of design, efficiency and conceptual compatibility has increased in time. The most important stage of yacht production in this sector is furniture making. It covers almost the two-third of total production time. Yacht furniture making has three different methods: on-site, mock-up and computer-controlled. In this context, it is very crucial to choose the appropriate production method depending on the characteristics of yacht, such as budget, size and process, and to follow the workflow of method in a correct way. Each method has different advantages and disadvantages. This study focuses on the mock-up method within the case of a yacht.

The definition of yacht is very broad, and it contains many classes, such as private yachts or charter yachts and sailing yachts or motor yachts. It is very critical to know what the requirements are in a yacht, to choose the right production method and to proceed according to the design. In this sense, taking right decisions about furniture making create big differences in workmanship quality, time management and design details. The aim of this study is to elaborate on mock-up method, with describing its process in sequence so as to emphasize its advantages and disadvantages in detail.

II. MATERIALS AND METHODS

Yacht production is a long process, takes too much time. Therefore, knowing the details and underlining the differences of furniture making methods are essential to define the right pro

duction path of a boat. Interview with the director of interior works of the boatyard: Adayachtworks in Bodrum on December 2018 and observation made in the company as an employee are the two main methods of data collection. The yacht named as 'Into the Breeze' which is still under construction in the boatyard, is the case of this study. The aim of working on a case is to understand the furniture making process not only in theory but also in practice. General specifications of the yacht is given below in Table 1.

Interview is a compilation of five open-ended questions: the first is on the materials and application methods used in flooring applications, the second is on the methods of fixing the furniture and with which criteria these fixation methods are chosen, the third is on how the revisions on customer request affected the budget and process, the fourth is on the advantages and disadvantages of mock-up method in furniture making and finally the fifth is on how the mock-up furniture making method can be elaborated on the basis of Into the Breeze project. Naturally, a big amount of data is recorded and reported at the end. Only the answers reasonable for this study are taken into the article. Observation on the other hand was reported in the internship file. Critical points of furniture design and production stages in the file are referred in the text.

TABLE 1 General Specifications of the Yacht, ADAYACTWORKS Archives

Builder	ADAYACHTWORKS
Hull Material	Steel
Superstructure Material	Aluminum
Type	Sailing Yacht
Length Overall	49.90m
Beam Overall	10.44m
Draft Max.	3.65m
Naval Architect	GINTON Naval Architects BV
Exterior Styling	GINTON Naval Architects BV & ADAYACHTWORKS
Interior Design	ADAYACHTWORKS
Class	RINA, Charter Class
Flag	Marshall Island,Commercial
Max./Cruising and Saling Speed	16,2 / 10 knots and 12.7 knots

III. FURNITURE MAKING METHODS

According to a study conducted in United Kingdom, furniture production in yacht manufacturing is seen as the second major cost factor after engine equipment. Cost ratios varies depending on the user requirements, the length of the yacht, the functionality of the furniture, the type of wood used, the fasteners and other reinforcement elements. Thus, considering the labor, furniture manufacturing is one of the main activities in yacht construction [1]. As it was mentioned above, there are three different methods of yacht furniture production: on-site method, mock-up method and computerized method. Certain criteria, such as qualifications, process capacity, material selection, design characteristics, time and budget, are by underneath the selection of these methods [2]. There are also four main factors: boat size, furniture production equipment and capacity, time and tolerance to decision changes [3]. Advantages and disadvantages of the selected method is also related to the project itself.

A. On-Site Method

The on-site method is the oldest and traditional way developed by the former skilled wooden craft builders. In fact, the method still exists in many small shipyards where the masters apply the techniques learned by their masters (Fig 1). There is a need for special attention and definite craftsmanship. On-site production is the right method to simplify the structure, find appropriate solutions on-site and accelerate production time [4]. In this method, after the hull production of the yacht completed, interior works start, in fact, at a certain stage, the two of them move together, so there is no need for a separate space for making furniture.

Fig 1: On-site furniture making in the hall of Ağanlar Shipyard, Bodrum, taken by author

As the structure of hull is inclined and curvilinear, efficient use of volumes becomes an important issue. Elements placed to the port or starboard side should be fixed and integrated to the structure which means, should follow its form by making a stepped furniture from the floor level to the ceiling to use small volumes behind, as storage areas. At this stage, on-site design solutions are needed, because some areas cannot be drawn in detail by the design office, but rather immediate shop drawings are required. As a result, the craftsmen decide on design, measure the dimensions, cut the part and replace it on its place. If the element does not fit, this should be repeated until it fits in. High quality handmade furniture plays an important role in the process.

Together with the design decisions, the production of both furniture and yacht is carried out in the same field, so the masters install the machines near the yacht, prepare the equipment and create an easy access path between. Some minor changes that occur inside are interfered on the spot, otherwise it is necessary to go out of the yacht several times to correct a single piece. Completed parts are removed and reassembled after varnish, lacquer or paint treatments in another workshop or in an isolated area nearby. After the general assembly is completed, fixtures are mounted, luminaires are added. The fact that the work is handmade, so it means it takes a longer time period than other methods.

B. Mock-up Method

In this method, yacht production and furniture production serve as two different organizations. While the yacht is in construction process, furniture production comes along. On the upshot, in this time-saving method, the construction of yacht and the production of furniture proceed in relation to each other. *Yacht interior outfitting has relatively narrow space, at the same time it needs to meet the demand of the client's aesthetic and its function. Designers need to comprehensively analyze the space, materials, technology and other aspects, and then make the reasonable layout and module partition of yacht interior outfitting* [5]. The mock-up method principally allows the design to be modularized and detailed (Fig 2). First, the skeleton of the cabins is formed according to the shell of the yacht [1]. Generally, in all yacht types, rooms are formed as a single piece, while lower deck for motor yachts can consist of two separate sections. This means a large area is required to produce furniture and in most cases outside the boatyard. Flooring, level differences, wall thicknesses and residual volumes are implemented as they are defined in the project. Detail drawings are hung on the walls. Such an application is not seen in other methods.

Fig 2: Mock-up furniture making in the hall of AdaYachtWorks, Bodrum, taken by author

Revisions and changes in the process are all filed and a continuous information flow is provided between the boatyard and furniture department. The furniture production department must be flexible and open to changes in the mock-up method. *The more the construction phase covering the boat detail and application process is kept under control, the less feedback and errors will be* [6]. When all furniture is finished, each piece is removed, coded and listed, all mounted in the yacht after varnishing and polishing. There is a planned and regular progressive process, so the margin of error is lower than the on-site method and the time requirement is less since two separate productions progress simultaneously.

C. Computerized Method

Computerized manufacturing method is an advanced way that has been developed and popularized in recent years. First, all the furniture is drawn in detail by the design team and production begins after the drawings are approved. This method is generally used for mega yachts and small-sized boats in mass production. It works in a huge closed area consisting of design, management and production sections. In this aspect, the division of labor, timing and process are very important [3]. Follow-up of this process, supplying materials, activity planning etc. requires a key person to monitor these issues. This person is responsible for the quality standards, as well as of the reports and documents and checking the accuracy of the end-product. After the design phase, there are two separated production stages: furniture production and cladding. Checking ensures flexibility during and between these two processes. Computer-aided manufacturing is not only about woodworking, but also metal works. For this reason, the factory must meet all the necessary equipment and must be a part of the project from the beginning to the end of the project. However, the costs of the equipment pool and its maintenance should also be taken into account when preparing the budget in this production method.

General arrangement in 2D and 3D drawings and render scenes are made by the concept office beforehand. Technical drawings stage for production is started after the project approved. Design section of furniture producer draws every element and their joint details. However, design is highly related to the production technology, so the capability of owned equipment by the producer. While the computerized method provides some flexibility, it also imposes some requirements. Taking all into the consideration, a timeline is created. Revisions and changes are not generally observed in this method unless it is necessary in the process. That is why, all parts of a furniture, plans, sections and elevations, as well as technical drawings and extruded models are prepared. Materials included in this project are selected and listed and the amount required for production is also calculated. This method needs a detailed and well-prepared production plan, contains a process with highest efficiency with often the lowest rate of error.

Most of the parts are cut by a CNC machine using drawings, while some are made by craftsmen. Many of the processes are controlled by the human, but they are made by the computer. All produced parts are assembled, coded, listed and packed for the installation. At the final stage, only few interior design decisions such as knobs, locks and handles can be revised. *Documentation of the whole process is critical in computerized method. The aim is to deliver the project on time with high quality and minimum margin of error* [3].

IV. MOCK-UP FURNITURE MAKING METHOD WITHIN THE CASE OF A YACHT

As it was mentioned above, an interview is made with Yasemin Çayır, the director of boatyard, Adayachtworks in Bodrum on December 10, 2018. The yacht named as 'Into the Breeze' which is still under construction in the boatyard, is the case of this study. Below are the questions and answers of the interview on the mock-up method of furniture making. It includes all stages of the method, its advantages and disadvantages, materials used, technical information and the details and joints of furniture.

1) What are the materials and application methods used in flooring applications?

Flooring is a sandwich system, generally consisting insulation material, marine plywood (usually made of birch) and vibration barrier. Based on the sequence, firstly 12 mm. thickness marine plywood is placed on the floor structure. Then, to provide isolation and flexibility, 5 mm. soft base covered on the plywood. Again, 12 mm. marine plywood panels are applied on the soft base and finally 10 mm. vibration barrier which is a spongy flexible material, glued over marine plywood. The desired floor material is applied on top of the last layer. This sandwich system is almost the same for most flooring applications.

2) What are the methods of fixing the furniture and these fixation methods are chosen depending on what criteria?

Furniture like beds, cupboards, cabinets, seating elements and tables can be fixed to the ceiling,

floor or walls in yacht interior spaces. Most of them is fixed to the walls. Screwing is the common application to fix a panel to its carcass. Similarly, the furniture is fixed to the floor with screws. These are usually wood screws, but for robustness and long-term use, especially in wet areas, chrome screws are used. In order to fix the furniture to the ceiling, vibration wedge is used, this way is preferred especially for sailing boats, because vibration wedges help absorb the vibration caused by the movement. Thus, the damage to the furniture is minimized and the noise generated by the movement is prevented.

3) How do the revisions on customer request affect the budget and process?

Since the greatest advantage of mock-up production method is to blend the design process with production, any changes that occur before mounting furniture in the yacht do not cause a significant rise in the budget. Moreover, mock-up is important not only for the firm, but also for the clients. Because it offers a more realistic and spatial perception than 3D rendering or sketches for them. Whence, clients understand the design and the space clearly in mock-up and therefore explain their wishes of revision directly and clearly. In addition, this method which facilitates the detailing during the production phase, increases the control and quality of workmanship, so the margin of error is reduced and the damage to the process and the budget is minimal in possible errors.

4) What are the advantages and disadvantages of mock-up method in furniture making?

Mock-up furniture making method has many advantages in terms of time, budget and design detail. All cause to important consequences that have a positive impact on the process. Above all, decision making goes simultaneously with yacht production which is very useful for both the customer and manufacturer. Because this method saves time in the process as well as allowing the design details to be more controlled, and finer workmanship creates a detailed, accurate and modular design suitable for the desired concept. While the boat is still in the welding phase, mock-ups are constructed according to the project and it allows the time to be increased for interior applications and detailed workmanship. In addition to that, ordering materials and products earlier is another advantage. Every component has a delivery time. For marine goods, the delivery durations extend from 2 to 6 weeks. If it is a special order, the duration could be even longer. Any delay related to any material could affect the delivery of the yacht. Moreover, this method provides the possibility of intervention and revision before the installation of furniture in the mock-up phase. This is another advantage of mock-up. It is a place where the opinions of craftsmen and designers are shared with the opinions of customer and necessary changes are made accordingly. Being able to see and navigate through the volumes (Fig 3) provides the detailed controls and a visual presentation to the customer. This also helps to gain the approval of work easily, sure if it is successful to realize some design considerations such as the coherence between concept and materials.

Fig 3: Couch in master cabin mock-up, taken by author

Even though with the help of technology nowadays interiors can be presented digitally as render or virtual reality, bare eye examination is always a step ahead (Fig 4). This method makes the client relieved by showing the expectations are in realization. The only disadvantage of the method is flaw, the goods that are ready before assembly could be damaged if the preventions are not enough, so every product after the presentation has to be carefully packed and safely piled.

Fig 4: 3D render and technical drawings at mock-up wall, taken by author

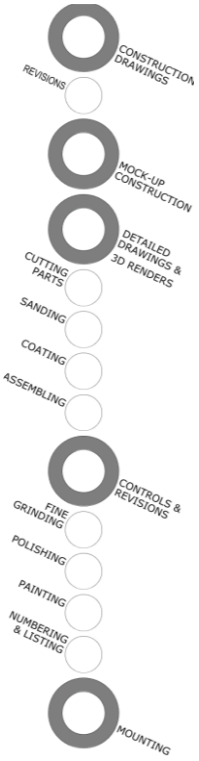
In the planning phase, first, naval engineers prepare the construction drawings of yacht. Then, stability calculations and revisions are made together with product designers and engineers. Later, interior architects make the sketches and draw the plan layout, sections and interior elevations and define the dimensions of all spaces and elements according to a decided concept. After all drawings are approved, designers start to work on detailed production drawings and modular components, also prepare 3D renders and material boards. Lastly, materials and fixtures are listed for each space. Their specifications, sizes, amounts and costs are placed in a long table which is called as documentation. Ordering them is inspected with using this table. Before starting the mock-up construction, the craftsman team should be informed about the general concept and details of the yacht with both technical drawings and renderings. First the frames cut out of MDF panels to create mock-up volumes and the carcass system with 40 x 40 cm. cells is made for the walls (Fig 5).

Fig 5: Wall carcass in mock-up, taken by author

5) How can be the mock-up furniture making method elaborated based on Into the Breeze project?

Design package is usually approved at the same period with the beginning of production phase. Due to the high industrial / fast consumption conditions of our time, most of the clients would like to have the delivery in one year, which means a very limited time. The structure, mechanics, wiring and furnishing have to be ready in that duration, and the yacht itself has to be tested on many aspects. What separates the furnishing from other components of the yacht is, it is the last layer that will be examined by the client. Most of the work is behind the last layer, but the interior is visible to see whether it answers the needs of client and to see if there is the desired ambiance existed. The interior has to be well planned with every component, design, layout, materials, lighting and so on. It has to have solutions for the needs & requirements of the client and has to give pleasure, since a yacht is a luxury item. Therefore, interior works should not be in rush to be perfect and that is why the mock-up method is important in this sense and preferred [7]. The steps of mock-up method can be listed as follows in the Table 2:

TABLE 2
Scheme of Mock-up Furniture Making Process,



Furniture production phase begins with sizing, cutting & sanding the solid wood elements that forms the structure of furniture. Sanding process is performed by hand or related machinery depending on the edge detail of the piece. The processed elements are rehearsed to be refined for the best result, then all the pieces are separated according to their surface finish such as veneer, lacquer or upholstery. In AdaYachtWorks, elements are taken into different lanes of production. Veneering process is mostly done by machinery for plain parts, while the round turns are made by handcrafting. Lacquering in low volume is done by manually also. For high volumes, machinery is preferred by firm to provide stabilization and uniqueness of color applications. The lacquering steps in line are undercoating, filling and finishing paint. Between each step, the piece has to be dried to an expected level. Veneered parts are also stopped in painting atelier for polishing depending on design. If the design offers the wood natural looking, it may be left as it is, mostly in luxury interiors only polish is applied. The steps in line are undercoating, filling and polishing in this case. In upholstery works with moulding, they should be covered with right amount of fiber and foam. If it is a ceiling or wall upholstery, the firm use a very smooth, thin fiber lining and if it is a seating unit, a combination of different densities of foam is

preferred. Afterwards, as the final surface: leather or fabric is applied with appropriate stitching detail. Metal works also, include sizing and sanding. Metals that are reachable and touchable should be exactly flawless in surface. And the materials - last finishes have to be compatible with marine conditions.

There AdaYachtWorks makes a review, first an internal discussion with designers, engineers and workers, later, an external discussion with clients. After recommended retouches and final controls are completed, all the parts are disassembled and coded. When the yacht structure is ready, all are carried to the boat to be reassembled (Fig 6). There are some elements may not be taken to the boat at first hand to preserve its last finish or to eliminate reassemble difficulties especially lacquered pieces. When it was ensured that these pieces can be carried to its location on a safe route in the narrow zones such as corridors, doors and stairs, then it was done. After the reassembly in yacht, there are last checkups with open - close accessorized items such as drawers, cabinets and final finishing.

Fig 6: Listed & stored furniture pieces of crew cabins, taken by author

V. CONCLUSION

This article deals with the furniture making methods, especially the mock-up, in the growing yacht sector. Focused on the benefits of mock-up also its phases of design and production were described detailly. Differences of the three methods of furniture making have been examined through the observation and interview. The advantages and disadvantages of mock-up were detected, and the production process is explained within a case study. The case is a luxury yacht named as 'Into the Breeze' which is still under construction in AdaYachtWorks's boatyard in Bodrum.

As a result, it can be stated that the mock-up method is more advantageous than other methods in many aspects: saves time, makes conceptual design and precise craftsmanship work together, easier and provides a visual perception of what is realized during the ongoing production, safer and finally facilitates the budget management. Mock-up method does not need a high-budget like computerized method. It is ease in production and fast enough in workflow. The method is more practical, open to changes, controllable and modular which is appropriate for the case from the viewpoint of customer and manufacturer. If the capacity of company, number of workers, size of the yacht, time and budget of the project are taken into consideration, it is clear that the mock-up method is the most accurate furniture making method.

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